CLAIMS

What is claimed is:

1. An apparatus for separating signals from a wavelength multiplexed signal, the apparatus comprising:

an optical circulator having a first port positioned and arranged to receive the wavelength multiplexed signal, a second port positioned and arranged to output the wavelength multiplexed signal, and a third port positioned and arranged to output signals input at the second port;

an optical pump optically coupled to the second port;

a fiber amplifier optically coupled to the optical pump; and

a spectrally selective reflecting grating optically coupled to the fiber amplifier.

2. An apparatus as in claim 1, wherein the fiber amplifier comprises an erbium doped fiber amplifier.

3. An apparatus as in claim 2, wherein the optical pump further comprises the erbium doped fiber amplifier.

4. An apparatus as in claim 1, wherein the spectrally selective reflecting grating is a fiber Bragg grating.

5. An apparatus as in claim 4, wherein the fiber Bragg grating is integrally built in with the fiber amplifier.

6. An apparatus for separating signals from a wavelength multiplexed signal, the apparatus comprising:

an optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to output signal received from the first port and to receive the wavelength multiplexed signal through a fiber amplifier, a third port positioned and arranged to output signals input at the second port and receiving input signals, and a fourth port positioned and arranged to output signals input at the third port;

an optical pump optically coupled to the first port;

the fiber amplifier optically coupled to the second port; and

a spectrally selective reflecting grating optically coupled to the third port.

7. An apparatus as in claim 6, wherein the optical pump is optically coupled to the first port.

8. An apparatus as in claim 6, wherein the fiber amplifier is an erbium doped fiber amplifier.

9. An apparatus as in claim 8, wherein the erbium doped fiber amplifier is integrally built in at the second port.

10. An apparatus as in claim 6, wherein the spectrally selective reflecting grating is a fiber Bragg grating.

11. An apparatus as in claim 10, wherein the fiber Bragg grating is integrally built in at the third port.

12. A system for separating signals from a wavelength multiplexed signal using an optical circulator, said optical circulator having a first port positioned and arranged to receive the wavelength multiplexed signal, a second port positioned and arranged to output the wavelength multiplexed signal and receiving input signals, and a third port positioned and arranged to output signals input at the second port, the system comprising:

means for receiving the wavelength multiplexed signal from the second port;

means for amplifying the wavelength multiplexed signal, wherein an amplified signal results; and

means for reflecting a component of the amplified signal, said component having a selected wavelength, into the second port, wherein the component exits through the third port.

13. A system as in claim 12, wherein said means for amplifying the wavelength multiplexed signal comprises means for optically pumping the wavelength multiplexed signal in a doped fiber amplifier attached to the second port.

14. A system as in claim 13, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

15. A system as in claim 12, further comprising means for applying the amplified signal to a fiber Bragg grating, wherein the component of the amplified signal reflects back into the second port.

16. A system for separating optical signals from a wavelength multiplexed signal using an optical circulator, said optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to output signal received from the first port and to receive the wavelength multiplexed signal through a fiber amplifier, a third port positioned and arranged to output signals input at the second port and receiving input signals, and a fourth port positioned and arranged to output signals input at the third port, the system comprising:

means for amplifying and receiving the wavelength multiplexed signal in the second port, wherein an amplified signal results;

means for outputting the amplified signal from the third port; and

means for reflecting a component of the amplified signal, said component having a selected wavelength, into the third port, wherein the component exits through the fourth port.

17. A system as in claim 16, wherein said means for amplifying the wavelength multiplexed signal comprises means for optically pumping the wavelength multiplexed signal in a doped fiber amplifier attached to the second port.

18. A system as in claim 17, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

19. A system as in claim 17, wherein the optical pumping is performed using an optical pump attached to the first port.

20. A system as in claim 19, further comprising means for applying the amplified signal to a fiber Bragg grating, wherein the component of the amplified signal reflects back into the third port.

21. A method of separating signals from a wavelength multiplexed signal using an optical circulator, said optical circulator having a first port positioned and arranged to receive the wavelength multiplexed signal, a second port positioned and arranged to output the wavelength multiplexed signal and receiving input signals, and a third port positioned and arranged to output signals input at the second port, the method comprising:

receiving the wavelength multiplexed signal from the second port;

amplifying the wavelength multiplexed signal, wherein an amplified signal results; and

reflecting a component of the amplified signal, said component having a selected wavelength, into the second port, wherein the component exits through the third port.

22. A method as in claim 21, wherein said amplifying the wavelength multiplexed signal comprises optically pumping the wavelength multiplexed signal in a doped fiber amplifier attached to the second port.

23. A method as in claim 22, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

24. A method as in claim 21, further comprising applying the amplified signal to a fiber Bragg grating, wherein the component of the amplified signal reflects back into the second port.

25. A method of separating optical signals from a wavelength multiplexed signal using an optical circulator, said optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to output signal received from the first port and to receive the wavelength multiplexed signal through an optical pump, a third port positioned and arranged to output signals input at the second port and receiving input signals, and a fourth port positioned and arranged to output signals input at the third port, the method comprising:

amplifying and receiving the wavelength multiplexed signal in the second port, wherein an amplified signal results;

outputting the amplified signal from the third port; and

reflecting a component of the amplified signal, said component having a selected wavelength, into the third port, wherein the component exits through the fourth port.

26. A method as in claim 25, wherein said amplifying the wavelength multiplexed signal comprises optically pumping the wavelength multiplexed signal in a doped fiber amplifier attached to the second port.

27. A method as in claim 26, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

28. A method as in claim 26, wherein the optical pumping is performed using an optical pump attached to the first port.

29. A method as in claim 25, further comprising applying the amplified signal to a fiber Bragg grating, wherein the component of the amplified signal reflects back into the third port.

30. An apparatus for multiplexing optical signals, the apparatus comprising:

an optical circulator having a first port positioned and arranged to receive a first signal, a second port positioned and arranged to output the first signal and receive input signals, and a third port positioned and arranged to output signals input at the second port;

an optical pump optically coupled to the second port;

a fiber amplifier optically coupled to the optical pump; and

a spectrally selective reflecting grating optically coupled to the fiber amplifier.

31. An apparatus as in claim 30, wherein the fiber amplifier comprises an erbium doped fiber amplifier.

32. An apparatus as in claim 31, wherein the optical pump further comprises the erbium doped fiber amplifier.

33. An apparatus as in claim 30, wherein the spectrally selective reflecting grating is a fiber Bragg grating.

34. An apparatus as in claim 33, wherein the fiber Bragg grating is integrally built in with the fiber amplifier.

35. An apparatus for multiplexing optical signals, the apparatus comprising:

an optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to receive the optical pump input and receive an input signal, a third port positioned and arranged to output signals input at the second port and receive input signals, and a fourth port positioned and arranged to output signals input at the third port;

a first spectrally selective reflecting grating to reflect the optical pump input optically coupled to the second port;

a fiber amplifier optically coupled to the third port; and

a second spectrally selective reflecting grating, to reflect the signal input in the second port, optically coupled to the fiber amplifier.

36. An apparatus as in claim 35, wherein the optical pump is optically coupled to the first port.

37. An apparatus as in claim 35, wherein the fiber amplifier is an erbium doped fiber amplifier.

38. An apparatus as in claim 37, wherein the erbium doped fiber amplifier is integrally built in at the third port.

39. An apparatus as in claim 35, wherein the first spectrally selective reflecting grating and the second spectrally selective reflecting grating are fiber Bragg gratings.

40. A system for multiplexing optical signals using an optical circulator having a first port positioned and arranged to receive a first signal, a second port positioned and arranged to output the first signal and receive input signals, and a third port positioned and arranged to output signals input at the second port, the system comprising:

means for receiving the first signal from the second port;

means for amplifying the first signal, wherein an amplified first amplified signal results;

means for reflecting the first amplified signal back into the second port;

means for amplifying a second signal, wherein a second amplified signal results;

means for inputting the amplified second signal into the second port; and

means for outputting a multiplexed signal through the third port.

41. A system as in claim 40, wherein said means for amplifying the first signal, and said means for amplifying the second signal comprise means for optically gaining the first signal in a doped fiber amplifier attached to the second port, and means for optically gaining the second signal in a doped fiber amplifier attached to the second port.

42. A system as in claim 41, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

43. A system as in claim 40, wherein the means for reflecting the first signal comprises a spectrally selective reflecting grating.

44. A system as in claim 43, wherein the spectrally selective reflecting grating comprises a fiber Bragg grating.

45. A system of multiplexing optical signals using an optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to receive the optical pump input and receive a first signal, a third port positioned and arranged to output signals input at the second port and receive input signals, and a fourth port positioned and arranged to output signals input at the third port, the system comprising:

means for receiving the first signal from the third port;

means for amplifying the first signal, wherein an amplified first signal results;

means for reflecting the first signal back into the third port;

means for amplifying a second signal, wherein an amplified second signal results;

means for inputting the second signal into the third port; and

means for outputting a multiplexed signal through the fourth port.

46. A system as in claim 45, wherein said means for amplifying the first signal, and said means for amplifying the second signal comprise means for optically gaining the first signal in a doped fiber amplifier attached to the third port, and means for optically gaining the second signal in the doped fiber amplifier attached to the third port.

47. A system as in claim 46, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

48. A system as in claim 45, wherein the means for reflecting the first signal comprises a spectrally selective reflecting grating.

49. A system as in claim 48, wherein the spectrally selective reflecting grating comprises a fiber Bragg grating.

50. A method of multiplexing optical signals using an optical circulator having a first port positioned and arranged to receive a first signal, a second port positioned and arranged to output the first signal and receive input signals, and a third port positioned and arranged to output signals input at the second port, the method comprising:

receiving the first signal from the second port;

amplifying the first signal, wherein an amplified first signal results;

reflecting the amplified signal back into the second port;

amplifying a second signal, wherein an amplified second signal results;

inputting the amplified second signal into the second port; and

outputting a multiplexed signal through the third port.

51. A method as in claim 50, wherein said amplifying the first signal, and said amplifying the second signal comprise optically gaining the first signal in a doped fiber amplifier attached to the second port, and optically gaining the second signal in a doped fiber amplifier attached to the second port.

52. A method as in claim 51, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

53. A method as in claim 50, wherein the reflecting the first signal comprises reflecting the first signal from a spectrally selective reflecting grating.

54. A method as in claim 53, wherein the spectrally selective reflecting grating comprises a fiber Bragg grating.

55. A method of multiplexing optical signals using an optical circulator having a first port positioned and arranged to receive an optical pump input, a second port positioned and arranged to receive the optical pump input and receive a first signal, a third port positioned and arranged to output signals input at the second port and receive input signals, and a fourth port positioned and arranged to output signals input at the third port, the method comprising:

receiving the first signal from the third port;

amplifying the first signal, wherein an amplified first signal results;

reflecting the first signal back into the third port;

amplifying a second signal, wherein an amplified second signal results;

inputting the second signal into the third port; and

outputting a multiplexed signal through the fourth port.

56. A method as in claim 55, wherein said amplifying the first signal, and said amplifying the second signal comprise optically gaining the first signal in a doped fiber amplifier attached to the third port, and optically gaining the second signal in a doped fiber amplifier attached to the third port.

57. A method as in claim 46, wherein said doped fiber amplifier comprises an erbium doped fiber amplifier.

58. A method as in claim 45, wherein the reflecting the first signal comprises reflecting the first signal from a spectrally selective reflecting grating.

59. A method as in claim 48, wherein the spectrally selective reflecting grating comprises a fiber Bragg grating.